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Abstract follows:

BEACON MONITOR OPERATIONS FOR EARTH ORBITING MISSIONS

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This paper explores how the Beacon Monitor operational concept and component technologies can be adapted for use on earth-orbiting missions. The Beacon Monitor Operations technology is currently being developed to lower the cost of routine operations on deep space missions and will be flight validated beginning in July 1998 on NASA's New Millennium Program Deep Space One (DS1) mission. With the deep space approach, the spacecraft determines the urgency of ground response and coveys that level of urgency to the ground using a simple signal that can be detected using smaller aperture antennas. When the beacon 'tone' indicates that tracking is required, a larger ground antenna is scheduled and summarized spacecraft data is telemetered to the ground. An on-demand operations team assembles only when necessary to analyze summary data and plan the ground response. Beacon signaling, though likely implemented differently for earth orbiters, can enable significant ops cost savings by reducing the frequency of contact and can increase effectiveness of onboard science activities by minimizing experiment down-time. Intelligent onboard summarization decreases the workload on operations personnel by reducing analysis time and data management/archiving activities. Summarization can be performed on the ground but in the long-run, higher payoff is likely if the algorithms reside onboard the satellite.

Flight software for summarization integrates several techniques into one cohesive architecture for providing operators with information required to analyze satellite engineering data. The method for creating the summary data is highly event-driven and uses the data prioritization capabilities built into the telemetry management software. It has been a design goal to integrate the most advanced techniques possible into the architecture. AI-based techniques for computing transforms and adaptive alarm thresholds are key components of an architecture that creates top-level summary statistics, episode data (high-resolution culprit and causally related data), low-resolution "snapshot" telemetry, and user-defined data. The technique for achieving dynamic, adaptive alarm thresholds is provided by the ELMER technology developed at JPL. Limits become dynamically changing values instead of static constants. These limits are functional values based upon the values of related sensors and other factors, such as the current operational mode of the satellite. Since the learned envelopes are tighter than red-lines, they have a much lower missed alarm rate. Novel training methods are being employed to avoid bounds which cause alarms in nominal data.

Moving to a paradigm where downlink is infrequent also requires new approaches for data visualization on the ground. Since the onboard software provides data at variable resolution. The

operator will need to quickly locate the high resolution episode data and will likely use the low resolution (snapshot) data for gaining overall system context. An incremental development process is being used with an end vision to develop automated software that searches the data for important information identified in the downlink and guides the operator through analysis of that data.

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